OPERATIONAL ALIGNMENT IN PREDATOR TRAINING RESEARCH

Noah P. Schill[*], Leah J. Rowe[†], Brian L. Gyovai[‡], DeForest Q. Joralmon[§], Andrew J. Schneck[**], Darrin A. Woudstra[††]

The sixteen year old USAF RPA program recently surpassed 2 million hours of flight time – the second million was achieved in a mere two and a half years between 2011 and 2013. Though aircrews are flying more hours, their exposure to mission critical events like weapons employment or emergency procedures may be limited due to the relative infrequency of such events. A consequence of the higher ops tempo is fewer hours to train, so warfighters demand efficient and effective training. The Integrated Combat Operations Training-Research Testbed (ICOTT) at the Air Force Research Laboratory (AFRL) in Dayton Ohio has an ongoing effort by a team of researchers, engineers, subject matter experts, and warfighters to cultivate an operationally relevant training research environment. To provide targeted RPA training research solutions, the team has developed the Predator Research Integrated Networked Combat Environment (PRINCE), a high-fidelity, non-proprietary, open architecture, networkable MQ-1 Remotely Piloted Aircraft (RPA) simulator. The program is relatively young, only getting to the evaluation phase this year, but the buy-in from the warfighter is already significant. The Ohio Air National Guard's 178th Reconnaissance Group provided four SMEs to work with researchers and engineers to develop relevant training scenarios for RPA crews. Since May 2013, 21 aircrews have conducted 126 hours of competency based training, providing expert feedback and evaluation of PRINCE. A capabilities survey found that, even at this early stage in development, PRINCE provides an environment in which 53% of MQ-1 aircrew tasks can be trained to fully or with some limitations. This paper addresses the warfighter-centric methods used to identify training gaps, develop the PRINCE simulator, construct scenarios, and assess capabilities.

[*] 1st Lt Noah P. Schill, USAF, Air Force Research Laboratory, 711th Human Performance Wing, Warfighter Readiness Research Division.
[†] Leah J. Rowe, USAF, Air Force Research Laboratory, 711th Human Performance Wing, Warfighter Readiness Research Division.
[‡] Lt Col Brian L. Gyovai, OHANG, 178th Operations Support Squadron.
[§] Dr. DeForest Q. Joralmon, L-3 Communications, Warfighter Readiness Research Division.
[**] Andrew J. Schneck, L-3 Communications, Warfighter Readiness Research Division.
[††] Darrin A. Woudstra, L-3 Communications, Warfighter Readiness Research Division.

Distribution A: Approved for public release; distribution unlimited. 88ABW-2014-1875 on 23 Apr 2014

Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE **21 APR 2014**	2. REPORT TYPE **N/A**	3. DATES COVERED **-**

4. TITLE AND SUBTITLE **Operational Alignment in Predator Training Research**	5a. CONTRACT NUMBER 5b. GRANT NUMBER 5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S) **Noah P. Schill, Leah J. Rowe, Brian L. Gyovai, DeForest Q. Joralmon, Andrew J. Schneck, Darrin A. Woudstra**	5d. PROJECT NUMBER 5e. TASK NUMBER 5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **Air Force Research Laboratory Warfighter Readiness Research Division Continuous Learning Branch 2620 Q Street Wright Patterson AFB, OH 45433-7955**	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR'S ACRONYM(S) 11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release, distribution unlimited

13. SUPPLEMENTARY NOTES

14. ABSTRACT
The sixteen year old USAF RPA program recently surpassed 2 million hours of flight time the second million was achieved in a mere two and a half years between 2011 and 2013. Though aircrews are flying more hours, their exposure to mission critical events like weapons employment or emergency procedures may be limited due to the relative infrequency of such events. A consequence of the higher ops tempo is fewer hours to train, so warfighters demand efficient and effective training. The Integrated Combat Operations Training-Research Testbed (ICOTT) at the Air Force Research Laboratory (AFRL) in Dayton Ohio has an ongoing effort by a team of researchers, engineers, subject matter experts, and warfighters to cultivate an operationally relevant training research environment. To provide targeted RPA training research solutions, the team has developed the Predator Research Integrated Networked Combat Environment (PRINCE), a high-fidelity, non-proprietary, open architecture, networkable MQ-1 Remotely Piloted Aircraft (RPA) simulator. The program is relatively young, only getting to the evaluation phase this year, but the buy-in from the warfighter is already significant. The Ohio Air National Guards 178th Reconnaissance Group provided four SMEs to work with researchers and engineers to develop relevant training scenarios for RPA crews. Since May 2013, 21 aircrews have conducted 126 hours of competency based training, providing expert feedback and evaluation of PRINCE. A capabilities survey found that, even at this early stage in development, PRINCE provides an environment in which 53% of MQ-1 aircrew tasks can be trained to fully or with some limitations. This paper addresses the warfighter-centric methods used to identify training gaps, develop the PRINCE simulator, construct scenarios, and assess capabilities.

15. SUBJECT TERMS
RPA, UAV, UAS, training, teaming, Predator, Reaper

<table>
<tr><td colspan="3">16. SECURITY CLASSIFICATION OF:</td><td rowspan="2">17. LIMITATION OF ABSTRACT
SAR</td><td rowspan="2">18. NUMBER OF PAGES
11</td><td rowspan="2">19a. NAME OF RESPONSIBLE PERSON</td></tr>
<tr><td>a. REPORT
unclassified</td><td>b. ABSTRACT
unclassified</td><td>c. THIS PAGE
unclassified</td></tr>
</table>

INTRODUCTION

The US Air Force (USAF) Remotely Piloted Aircraft (RPA) program recently surpassed 2 million hours of flight time. The first million was achieved over the course of sixteen years (1995-2011), while a mere eighth of that time was required to reach the second million.[1] Though aircrews are flying significantly more hours, their exposure to mission critical events like weapons employment or emergency procedures are limited due to the relative infrequency of such events.

The Air Force Research Laboratory's (AFRL) Warfighter Readiness Research Division performs research in human performance methods and technologies that provide the warfighter the necessary knowledge and skill to dominate their operational environment. In recent years we have developed a RPA training research program. The first step in growing the program was beginning the development of Mission Essential Competencies[SM] (MECs) for Predator and Reaper). The MEC job analysis methodology enables the determination of training requirements and the appropriate mix of live operation and virtual training media necessary for training.[2] MECs are, "Higher-order individual, team, and inter-team competencies that a fully prepared pilot, crew, flight, operator, or team requires for successful mission completion under adverse conditions and in a non-permissive environment".[3]

The MEC development process includes four steps. First, MECs are defined by subject matter experts (SMEs) during facilitated workshops. Next, survey data is gathered from the operational community, followed by a detailed data analysis. Finally, the process is completed with a facilitated workshop where SMEs interpret and make recommendations about the survey data. Two of the primary training gaps identified by the MEC process for Predator and Reaper operators were that the ability to train weapons employment and coordination with the Joint Terminal Attack Controller (JTAC) were gaps in the current training that is available to the warfighter. As an organization with a strong history of warfighter-centric simulator development, and the original Live, Virtual, and Constructive (LVC)-capable JTAC dome, AFRL is uniquely positioned to provide a training research simulator which could address training gaps and collect data to help inform future training simulator requirements and development.

For training research to align with operational needs it is critical that research data be collected from a realistic training audience. In order to succeed at operationally relevant research it is key to have operators willing to participate in research activities. To achieve operator support it is necessary to provide a useful capability that is unique to the lab environment, in other words training that cannot be achieved anywhere else. Therefore, in our Integrated Combat Operations Training Research Testbed (ICOTT), we are able to provide time in a simulator where weapons can be employed and JTAC coordination can be completed. This operationally relevant training research effort is modeled after a long standing AFRL F-16 and Air Battle Manager (ABM) training research effort that has been vetted for over 12 years.[4]

To establish an RPA training research capability we focused on known training gaps (i.e., weapons training and JTAC coordination). Working closely with operational SMEs the AFRL training research team developed the Predator Research Integrated Networked Environment

(PRINCE) and is shown in Figure 1. PRINCE serves as a R&D tactical simulator for Predator pilots and sensor operators (SOs). The initial development of PRINCE took place over a period of 16 months. PRINCE is now being evaluated by operational pilots and SOs.

Figure 1. The Predator Research Integrated Networked Combat Environment

REQUIREMENTS

Recall the primary goal for the present work is to enhance training effectiveness for Predator pilots and SOs. In order to do so we determined a training testbed was critical to the success of our program. While developing the PRINCE simulator in the laboratory it is important to note that the requirements are different than those that would typically exist in commercial or operational settings. First cost is a major concern; in R&D settings funding is limited. Second, in order to assess training interventions and new capabilities non-proprietary systems are necessary. Third, leveraging existing off-the-shelf technologies is optimal as it often saves time and money. Next, it is important to have ready access to the code so that research interventions can be programmed. Finally open and modular systems are critical to allow for new technologies to be integrated and tested.

The objective of the PRINCE research program emphasized meeting known training gaps and not developing a Predator simulator with all the capabilities of the operational system. The Predator SME team emphasized that their priority is tactical requirements such as JTAC integration and weapons employment. Other capabilities such as Emergency Procedure (EP) simulation and launch and recovery procedures are low priority as they can be trained elsewhere and therefore are not included in PRINCE effort.

A number of technologies leveraged in PRINCE are enabled because the simulator uses a Distributed Interactive Simulation (DIS) protocol. DIS is an Institute of Electrical and Electronics Engineers (IEEE) and Simulation Interoperability Standards Organization (SISO) standard that provides the capability to pass data in real-time over a network for coordinated training activities.[5] One of the integrated technologies is the Live, Virtual, and Constructive Network Control Suite (LNCS). LNCS records DIS data allowing for complete mission playback in after action review (AAR). Another AFRL tool, Performance Evaluation Tracking System (PETS) listens to DIS traffic to provide real-time performance assessment.[6] PETS can be used in conjunction with LNCS for AAR. Using DIS also ensures that PRINCE can connect to other DIS-enable simulators such as the JTAC dome or other assets.

SOFTWARE DEVELOPMENT

Integrating PETS and other research tools into an RPA simulator requires a non-proprietary simulation solution so AFRL researchers have full access to the code to build in hooks for assessment tools. At its core, PRINCE is based on technology and approaches fostered in the AFRL Gaming Research Integration for Learning Laboratory (GRILL), which had demonstrated the integration of several low-cost Commercial Off-the-Shelf (COTS) software packages to develop training technologies, including approaches to make the integration easier.[7]

The PRINCE development team opted for the following software:

1. CryEngine® 3 (version 3.4.1) serves as a high fidelity Image Generator. As the backbone of several modern video games, CryEngine® places a strong emphasis on realistic, physics-based environments in which to add objects, vehicles, animals, and people. The human models in CryEngine® can be animated to do a range of actions (i.e. smoking a cigarette, digging a hole). AFRL has also begun working to record very specific animations to add to CryEngine®. Furthermore, everything in the engine can be scripted – from something as simple as walking point A to B, to something as complex as behavioral responses, such as responding to hearing an explosion nearby. These are key to providing good training to the SO and, down the road, the Mission Intelligence Coordinator (MIC).
2. X-Plane 9 is COTS software and serves as the aeronautical simulation in PRINCE, providing very detailed aircraft system simulation (fuel, batteries, servos, control surfaces) which drive how the modeled MQ-1 Predator behaves in the CryEngine® environment.
3. The Ground Control Station(GCS) Emulator was developed in-house by the PRINCE engineering team and is the hub of every element of PRINCE. It emulates the MQ-1 by handling all network traffic produced in the simulator. Each element outputs traffic to the GCS Emulator which is the gatekeeper, passing relevant traffic to the elements which are affected by that data. The GCS also builds in an accurate signal delay between the time an input is given from the GCS and the time the aircraft responds.
4. The Heads Down Display (HDD) software was built from scratch in C# based on the supplement to the Predator flight manual, commonly referred to as the “Dash 1”. The HDD menus can be re-arranged with minimal code changes, a potential boon for human factors research on these menus.
5. Tracker Display, developed in Java, is one of the ways in which the aircrew can control the aircraft or increase their situational awareness. It uses standardized map data to to display several levels of detail.

6. Networked Integrated Combat Environment (NICE) produces Computer Generated Forces (CGF), the “constructive” element of LVC technology. It allows the instructor to insert red or blue forces into the scenario as DIS entities. At this stage, this is being used to clutter airspace in PRINCE, forcing aircrews to consider other aircraft in the execution of their mission.
7. The Performance Evaluation Tracking System (PETS) monitors DIS traffic on the simulator. This traffic is used to record performance data such as time from a radio call to weapon employment, or whether the aircrew launches weapons outside of the ideal Weapons Engagement Zone (WEZ).
8. Calytrix Comm Net Radio Simulator transmits radio communications via DIS and is used to maintain multiple push-to-talk and voice operated radio networks (one for the aircrew, one for the instructor and white cell station) to accurately model operational aircrew communications networks.
9. IRC (Internet Relay Chat) rooms are one of several forms of communication the aircrew uses to communicate with ground forces, command and control (C2) elements, and the Mission Intelligence Coordinator (MIC), among others.
10. LNCS (Live, Virtual, and Constructive Network Control Suite) provides a god’s-eye-view of the Area of Operations, but most importantly it records all DIS traffic on the simulator, including voice communications, for playback in AAR.
11. AAR recording and playback was implemented recently. The tool records every element of the scenario, including Pilot and SO views, HDD menus, voice comms, mIRC chat, tracker display, and god’s-eye-view maps.
12. The Instructor Operator Station (IOS) hosts the CryEngine® server, X-Plane, and various tools useful to the instructor, such as the NICE console. It also displays every screen on PRINCE using video repeaters, so instructors can follow the scenario from a distance.

The PRINCE engineering team has worked to future-proof the simulator by building it around an open architecture. This allows the team maintain the simulation backbone of the simulator but swap out peripheral software like the Image Generator (IG), aero model, chat software, or voice communication methods. Maintaining this modular approach ensures the PRINCE can be easily modified to address future needs.

HARDWARE DEVELOPMENT

PRINCE has relatively lightweight hardware requirements given that CryEngine® was developed to run on commercial desktop computers. The hardware requirements are especially low when compared to the racks of computers required to run other simulators. Including the Instructor Operator Station (IOS), PRINCE only requires five computers to run. The suggested specifications for a PC are Intel i7 3770K CPU, GeForce GTX 670 video card, and 16GB RAM.

The PCs are rack-mounted in a GCS rack with a few custom fabricated elements to fit COTS hardware. Though the GCS shell adds realism to the cockpit, it is not necessary. In fact, AFRL also built out a deployable version PRINCE which can be contained in a 25”x59”x33” roadie case. This significantly reduces the overall cost..

SCENARIO DEVELOPMENT

AFRL has a strong history of providing high quality training scenarios and environments which encourage willing participants to take part in research efforts. The goal is to develop a "playbook" from which teams can select scenarios which will train to their specific needs. We have relied on operational personnel as SMEs to develop a variety of scenarios. Our SME team has extensive experience; for instance, one of our team members has 800 hours in the Predator, over 1,000 in fighter aircraft, and is a graduate of the US Air Force Weapons School Instructor Course. To date, the PRINCE team has focused on two main scenarios: Basic Surface Attack (BSA) and Close Air Support (CAS). These scenarios address the most important gaps in their training, focusing on weapons employment, JTAC coordination, and troops in contact (TIC). Both scenarios have accompanying briefing materials and assessment sheets for instructors.

Because PRINCE is a research tool, it was important to develop scenarios which could be reliably repeated, include measureable outcomes to assess performance, and have varying levels of complexity. CryEngine® lends itself well to repeatable scenarios because key events can be scripted and initiated as appropriate, while distractor events like a villager walking around a market can be controlled by a simple Artificial Intelligence flowgraph which does not require instructor intervention to activate.

Basic Surface Attack Scenario

The BSA scenario is at an introductory level and is intended for aircrews which have not flown or employed weapons for some time. It introduces all of the concepts and tactics which will be required to successfully complete the CAS scenario: scanning patterns, target acquisition, positive identification (PID), on- and off-azimuth weapons employment, restricted approaches, moving vehicle follow, moving target weapons employment, and time on target (TOT) attacks. It also adds multiple-weapon employment on closely spaced targets, adding to the complexity of the mission, emphasizing crew problem solving.

Close Air Support Scenario

This is a more advanced scenario with little familiarization time and more concurrent activities for the aircrew manage. The scenario focuses on the following concepts and tactics: check-in with ground forces, convoy overwatch, scanning, target acquisition, weapons employment, JTAC coordination, airspace coordination, Troops in Contact (TIC) support, and multi Predator ops.

EVALUATION

PRINCE is a relatively young system and is only in the initial evaluation phase of development. a Operators are eager to train on PRINCE, and began scheduling weekly training (and research) sessions early in 2013. These sessions were training for the warfighters, but evaluations for the AFRL team. During these sessions, aircrews gave detailed feedback on what didn't match up to the actual MQ-1 GCS. This is where the non-proprietary nature of the sim really shone through – the engineers are able to make changes quickly, often on-the-fly while the operators are still at the GCS. To date, 29 aircrews consisting of more than 50 unique Airmen have assessed PRINCE for at least three hours each, with many spending as much as ten total hours at the station. Through these training research sessions we have been able to assess the training capabilities of PRINCE. To assess the training capabilities of PRINCE operational SMEs assessed the training capabilities of PRINCE and evaluated the effectiveness and suitability of the system. The assessment included 255 Pilot and 209 SO criteria assessing performance in every stage of aircraft operation. The tasks were graded based on a standard scale that is used in the USAF to assess simulation capabilities. Each task was graded based on the following criteria:

Full Training - The training device provides necessary elements to fully train the task. Task is certified for formal training and recommended for Ready Aircrew Program (RAP) accreditation.

Limitations to Training - The training device provides credible but incomplete training. Task is certified for formal training but is not recommended for RAP accreditation.

Unsatisfactory Training - Task is simulated but has negative training value or violates safety. Task is not certified for formal training.

Not Simulated - Training device does not provide simulation to train task. Task is not certified for training.

Not Applicable - Training task is not assigned to this training device. (Outside the scope of target training capabilities for PRINCE to provide).

Results

The PRINCE evaluation found that of the 255 tasks on the Predator training task list that 114 tasks could be simulated on PRINCE. The findings of the simulator capability evaluations indicate that pilots are able to receive Full Training for 54.4% of the tasks, Training with Limitations for 44.6% of the tasks, and Unsatisfactory Training for 1% of the tasks simulated by PRINCE..

Sensor Operators are able to receive Full Training for 41% of the tasks, Training with Limitations for 58% of the tasks, and Unsatisfactory Training for 1% of the tasks simulated by PRINCE. 46 SO tasks were Not Simulated, and 30 tasks were Not Applicable so were not included in in the total number of tasks.

Figure 2 shows the percentage of total tasks which can be trained at each level, separated by Pilot and SO.

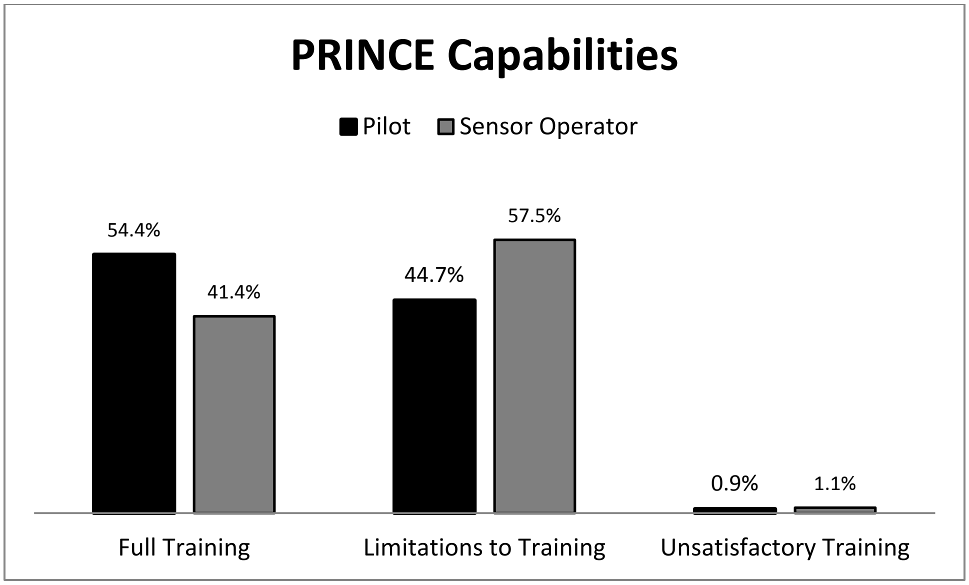

Figure 2. PRINCE capabilities assessment

FUTURE LOOK

As the fight changes, so do the warfighters' requirements. This keeps PRINCE development moving forward at a rapid rate, constantly maneuvering to add new capabilities. Just this year, Predator units are seeing the MQ-1 lose operational hours in favor of more MQ-9 hours. In fact, it's projected that all Air National Guard MQ-1 units will be switched to the MQ-9 by the close of 2015. With that in mind, the AFRL team is focusing on developing an MQ-9 build of PRINCE, which requires writing new Heads Down Display (HDD) menu systems, tracker display functions, Heads Up Display (HUD), flight model, SO taskbar, and weapons profiles. Fortunately, PRINCE was built with major upgrades in mind, so the development timeline for the MQ-9 build will be significantly shorter.

Now that PRINCE is through initial development and is at a stable point, the development team is working on connecting the sim to the in-house JTAC Training Research Simulator. This presents an interesting challenge as the PRINCE and JTAC teams must get a COTS non-standard terrain database to match up with the database of a GOTS military-focused Image Generator. Initial tests have shown that DIS packets are being sent and received, but entity models and terrain databases still need to be correlated.

The SO station will be improved by adding better IR (Infrared) modeling, including better control of brightness and contrast. These depend primarily on accurate IR information in CryEngine® models and applying shaders to the sensor ball view to control brightness and contrast. Automatic Video Tracks (AVTs) are used by the SO to ease tracking entities on the ground – these are based on brightness and contrast algorithms, so can be implemented after improving the IR picture.

The Mission Intelligence Coordinator (MIC) is truly the third member of the aircrew. Their role is to direct the ISR aspect of the mission, collecting sensitive information as required. Their tasks include coordinating ISR taskings with C2 cells, and working with the Distributed Common Ground Station (DCGS) to ensure Positive ID (PID) prior to weapons employment. They employ a wide variety of tools to execute their mission. Currently, there is no comprehensive training simulator for MICs which ties into MQ-1 simulators. Without the tie-in, MICs and RPA aircrews cannot train to a portion of their mission. Through Small Business Innovative Research (SBIR) efforts, AFRL anticipates adding a MIC simulator to the ICOTT with at least basic MIC capabilities. AFRL is working with operational MIC SMEs from the to ensure the simulator will be a useful tool.

CONCLUSION

Initial feedback is promising, showing that PRINCE is meeting the warfighters' requirements and exceeding their expectations. We are preparing to undergo training experiments examining the training effectiveness of RPA aircrews, and identifying how a low cost, high fidelity simulator can fill training gaps, complementing the Air Force family of simulators. This research is garnering attention from units around the country, several of which have expressed interest in participating in future research. Continued interest from operators will keep AFRL's RPA training research program flush with participants and focused on addressing the needs of the warfighter.

REFERENCES

[1] K., A. "U.S. Air Force News." RPAs reach 2 million hours. N.p., 23 Oct. 2013. Web. 8 Apr. 2014. <http://www.af.mil/News/ArticleDisplay/tabid/223/Article/467346/rpas-reach-2-million-hours.aspx>.

[2] Alliger, G M, R Beard, W Bennett, and C M Colegrove. "Understanding Mission Essential Competencies as a Job Analysis Method." In *The Handbook of Work Analysis Methods, Systems, Applications, and Science of Work Measurement in Organizations*, by M A Wilson, W Bennett, S Gibson and G M Alliger, 603-624. New York: Routledge, 2012.

[3] Colegrove, C. M., & Alliger, G. M. (2002, April). *Mission essential competencies: Defining combat mission readiness in a novel way*. Paper presented at the NATO RTO Studies, Analysis and Simulation Panel (SAS) Symposium, Brussels, Belgium.

[4] Schreiber, B. T., & Bennett, W., Jr. (2006). *Distributed mission operations within-simulator training effectiveness baseline study*. *Volume I: Summary report* (AFRL-HE-AZ-TR-2006 – 0015-Vol. I). Mesa, AZ: Air Force Research Laboratory, Warfighter Training Research Division.

[5] Schreiber, B. T., Watz, E. A., & Bennett, W. R. Jr. (2007, March). DIS: Does interoperability suffice? A need to set a higher standard. Paper presented at the 2007 Spring Simulation

Interoperability Workshop of the Simulation Interoperability Standards Organization (SISO), Norfolk, VA.

[6] Schreiber, B. T., Watz, E., Portrey, A. M., & Bennett, W., Jr. (2003). Development of a distributed mission training automated performance tracking system. In *Proceedings of the Behavioral Representations in Modeling and Simulation (BRIMS) conference* (pp. 301–317). Scottsdale, AZ.

[7] Winner, J. L., Nelson, S. F., & Burditt, R. L. (Fall 2011). Evaluation Criteria for Incorporation of Game Engines in Military Simulation and Training. Paper presented at 2011 North-American Simulation Technology Conference, Troy, NY.

APPENDIX: LIST OF ACRONYMS

AAR	After Action Review
AFRL	Air Force Research Laboratory
AI	Artificial Intelligence
AO	Area of Operations
ATD	Aircrew Training Device
AVT	Automatic Video Track
BSA	Basic Surface Attack
C2	Command and Control
CAS	Close Air Support
CGF	Computer Generated Forces
COTS	Commercial Off The Shelf
DGS	Distributed Ground Station
DIS	Distributed Interactive Simulation
EP	Emergency Procedure
GCS	Ground Control Station
GOTS	Government Off The Shelf
GRILL	Gaming Research and Integration for Learning Laboratory
HDD	Heads Down Display
HUD	Heads Up Display
ICOTT	Integrated Combat Operations Training-Research Testbed
IEEE	Institute of Electrical and Electronics Engineers
IOS	Instructor Operator Station
IR	Infrared
JTAC	Joint Terminal Attack Controller
LNCS	LVC Network Control Suite
LVC	Live, Virtual, and Constructive
MEC	Mission Essential Competency™
MIC	Mission Intelligence Coordinator
NICE	Networked Integrated Combat Environment
PETS	Performance Evaluation Tracking System
PRINCE	Predator Research Integrated Networked Collaborative Environment
RAP	Ready Aircrew Program
RPA	Remotely Piloted Aircraft
SA	Situational Awareness

SISO	Simulation Interoperability Standards Organization
SME	Subject Matter Expert
SO	Sensor Operator
TIC	Troops in Contact
TOT	Time on Target
TS	Training System
USAF	United States Air Force
WEZ	Weapons Engagement Zone